REMARKS

The Office Action mailed January 5, 2007 has been received and reviewed. Claims 25, 26, 28, 33-36, and 42-44 are pending in the application. Claims 25, 26, 28, 33-36, and 42-44 are objected to. Claims 25, 26, 28, 33-36, and 42-44 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent 6,103,619 to Lai.

Objections to the Claims

Claim 25 is objected to for reciting the term "a second opposite side of the silicon nitride layer" without first reciting a first opposite side. By this amendment the claim has been amended to recite a first surface and a second surface opposite the first surface.

Claim 25 is objected to for reciting "a mask layer formed over the silicon nitride layer and having an opening therethrough" without reciting which of the two layers the opening is formed through and its positional relationship with the opening formed in the silicon nitride layer. By this amendment claim 25 has been amended to recite "a mask layer formed over the silicon nitride layer, the mask layer having an opening therethrough positioned over the tapered opening and having a dimension less than the second dimension of the tapered opening of the silicon nitride layer."

Claim 25 is objected to for reciting "a first side adjacent," rather than "a first side of the nitride layer adjacent to." By this amendment claim 25 has been amended to recite "a first surface of the silicon nitride layer adjacent to," as suggested by the examiner.

Claim 33 is objected to as reciting terms of dimension along the first and second sides without clarifying the directions of the first and second sides along which the dimensions are measured. By this amendment, the first and second sides have been amended to recite upper and lower surfaces.

Claim 42 is objected to for reciting "a second opposite side of the layer" without reciting a first opposite side of the layer. By this amendment claim 42 has been amended to recite a first side and a second side opposite the first side.

Discussion of the Disclosed Embodiment

The disclosed embodiments of the invention provide a means for dealing with "step coverage" defects caused when layers grown over steps in a substrate tend to grow such that voids are captured within the layer. In some embodiments, a silicon structure includes a silicon nitride layer, a pad oxide layer, and a substrate. A mask layer is formed on the silicon nitride layer and an opening formed therein. A etching compound is introduced such that the silicon nitride layer is eaten away. Leaving the mask layer overhanging a tapered opening in the silicon nitride layer as shown in Figure 3E. A trench may then be formed in the pad oxide layer and the substrate. As illustrated in the application, the trench has a width at its top that is substantially equal the width of the narrow end of the tapered opening formed in the silicon nitride layer.

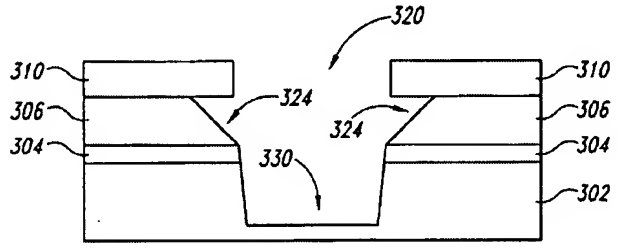

Fig. 3E

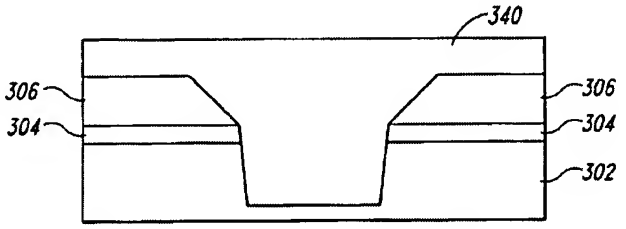

Fig. 3G

The mask layer may be removed and an insulative layer grown on the silicon nitride layer and exposed portions of the pad oxide layer and the substrate, as shown in Figure 3G. The tapered opening in the silicon nitride layer serves to hinder the creation of voids in the insulative layer.

Discussion of the Cited Reference

Lai discloses a method for forming a dual damascene structure. At one stage in the method a silicon nitride layer (64) is etched horizontally to create the structure shown in Figure 12. The structure of Figure 12 is subsequently etched and a conductive material deposited thereon .

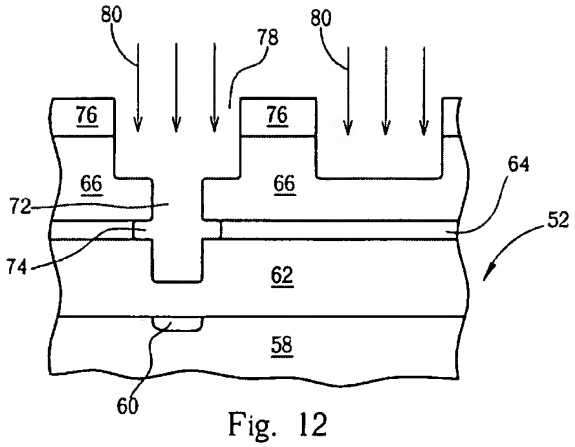

Fig. 12

It is apparent from Figure 12 that the opening in the silicon nitride layer (64) at both the top and the bottom of is much larger than the depression formed in the inter-layer dielectric (62). It is also apparent that the opening in the layer (64) is not tapered. Lai teaches that the silicon nitride layer (64) is subject to "an isotropic horizontal etch," Col. 4, ln. 18, and does not state that this process will result in a tapered opening.

Furthermore, Lai states that the structure is subject to reactive ion etching (RIE), Col. 4, lns. 30-53, which is directional such that material removal progresses in the vertical direction. As is apparent in Figure 7, when the opening in the silicon nitride layer (64) is filled with a conductive plug the opening in the nitride layer (64) has straight sides. Although the silicone nitride layer (64) is less subject to the RIE process than the ILD layer (62) it is nonetheless removed as is apparent in Figure 7 – the thickness of the silicon nitride in exposed areas is reduced after the RIE step. Lai therefore does not teach or suggest forming any layers, conductive or insulative, on a tapered opening in a silicon nitride layer.

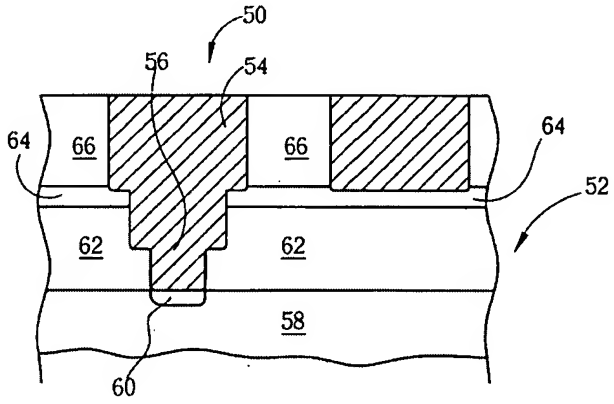

Fig. 7

Discussion of the Claims

Turning now to the claims, the difference between the cited references and the claimed invention will be pointed out.

With respect to claim 25, Lai fails to teach or suggest, in combination with the other limitations of the claim, a semiconductor structure having "a layer of a silicon nitride formed over the substrate and having a tapered opening therethrough over the trench, the tapered opening having *a first dimension on a first surface of the silicon nitride layer adjacent to the trench less than a second dimension on a second surface of the silicon nitride layer opposite the first surface of the silicon nitride layer, the first dimension being substantially equal a width of the trench proximate the first surface*." (emphasis added).

With respect to claim 33, Lai fails to teach or suggest, in combination with the other limitations of the claim, a semiconductor structure having "a first layer of a silicon nitride material formed over the substrate and having a lower surface proximate to the substrate and an upper surface opposite of the lower surface, and further having an opening therethrough over the trench, the opening having *a first dimension dimension along the upper surface greater than the first dimension, the first dimension being substantially equal a width of the trench proximate the lower surface; and an insulating layer formed over the first layer of silicon nitride material and extending into the opening and the trench*." (emphasis added).

With respect to claim 42, Lai fails to teach or suggest, in combination with the other limitations of the claim, a semiconductor structure comprising "a first layer of insulating material formed over the substrate and having a tapered opening therethrough over the trench, *the tapered opening having a first dimension on a first side adjacent the trench less than a second dimension on a second side of the first insulating layer opposite the first side; and a second layer of insulating material is formed over the first insulating layer and extending into the opening and the trench*." (emphasis added).

Claims 26, 28,34-36, and 43-44 are dependent on allowable claims 25, 33, and 42, respectively, and are therefore allowable.

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a timely Notice of Allowance are earnestly solicited.

Respectfully submitted,

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